

**REMARKS**

Claims 1-4, 7-8, 10-15, 19-20, 22-23, 25-33 are pending. Claims 5-6, 9, 16-18, 21, and 24 were previously canceled.

Claims 29 -32 have been canceled.

Claims 1, 2, 4, 11, 12, 13, 22, 23, and 33 have been amended to more clearly recite the subject matter of the present disclosure. Particularly, the independent claims (claims 1, 2, 12, 13, 22, 23, and 33) have been amended to recite "and wherein the precursor graphite is expanded more than graphite treated to 600°C to 1200°C by direct application of heat." Support for this amendment exists in the specification with respect to paragraph [0007] and [0069].

No claims are allowed.

**I. SUMMARY OF OBJECTIONS/REJECTIONS**

The examiner sets forth the following objections/rejections:

1. Objection of the amendment filed 5/10/07 under 35 U.S.C. § 132(a) for allegedly introducing new matter into the disclosure for the range "up to five minutes" is maintained from his previous rejection. (See Office Action, ¶ 2.)

2. Claim 1-4, 7-8, 10-15, 19-20, 22-23, and 25-33 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. In particular, the examiner takes issue with the recitation of: (A) "a few seconds to 5 minutes," (See Office Action, ¶ 5A), and (B) "1040 Watts" (See Office Action, ¶ 5B).

3. Claim 1-4, 7-8, 10-15, 19-20, 22-23, and 25-33 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants

regard as the invention. In particular, the examiner takes issue with the recitation of: (A) "a few seconds to 5 minutes," (See Office Action, ¶ 6A).

5. The examiner maintains his rejection under 35 U.S.C. § 102(b) from the previous office action. Claims 1-4, 7-8, 10-15, 19, and 29-30 are rejected under 35 U.S.C. § 102(b) as being anticipated by Saito et al. U.S. Pat. No. 6,024,900 ("Saito") with Krassowski et al. U.S. Pat. No. 6,395,199 ("Krassowski") and Caines U.S. Pat. No. 4,199,628 ("Caines") being cited as evidence that the temperatures of Saito allegedly give the instantly claimed "worm-like" structure, (See Office Action, ¶ 9).

6. The examiner maintains his rejection under 35 U.S.C. § 103(a) from the previous office action. Claims 1-4, 7-8, 10-15, 19, and 29-30 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Saito with Krassowski and Caines being cited as evidence that the temperatures of Saito allegedly give the instantly claimed "worm-like" structure, (See Office Action, ¶ 10).

7. The examiner maintains his rejection under 35 U.S.C. § 103(a) from the previous office action. Claims 1-4, 7-8, 10-15, 19-20, 22-23, and 25-33 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Saito in view of Adams et al. U.S. Pat. No. 6,200,915 ("Adams"), Ottinger et al. U.S. Pre-Grant Publication No. 2002/0114952 ("Ottinger"), Blain et al. U.S. Pat. No. 6,413,601 ("Blain"), and Cha et al. U.S. Pat. No. 5,164,054 ("Cha"), Greinke et al. U.S. Pat. No. 6,555,271 ("Greinke"), Bonville U.S. Pat. No. 6,248,462 ("Bonville"), and Von Bonin et al. U.S. Pat. No. 5,288,429 ("Von Bonin") with Krassowski and Caines being cited as evidence that the temperatures of Saito allegedly give the instantly claimed "worm-like" structure, (See Office Action, ¶ 11).

## **II. INTERVIEW SUMMARY**

In response to the non-final office action dated July 21, 2009, a telephonic interview with Examiner Patrick D. Niland took place on July 28, 2009, at the request of Applicants' representative, Mikhail Murshak (Reg. No. 58,472).

Examiner Niland stated that "probative evidence" correlating the example in paragraph (8) of the Declaration Under 37 C.F.R. § 1.132 filed April 27, 2009 directed to surface area differences between conventional heating graphite expansion and microwave graphite expansion to the degree of expansion would place the claims in condition for allowance. The example in paragraph (8) states:

"(8.) For example, a 10g sample of commercially available acid intercalated graphite, Asbury Expandable Graphite Grade 3772, was expanded in a conventional oven at 1000°C. [Sample A] Also the same amount of the same sample was expanded by 915 MHz microwave at 10 kW. [Sample B] The surface area of sample B after microwave processing was 55 m<sup>2</sup>/g while that of sample A was 33 m<sup>2</sup>/g. Since the surface area after the expansion is an indicator of the degree of exfoliation, this result clearly shows that microwave process can exfoliate acid intercalated graphite more efficiently than a conventional heating process. Moreover, the improvement in expansion is not limited to this particular example. As a result of the mechanism described above, microwaving acid intercalated graphite will result in better expansion and thus a different structure than that of conventional heating."

Examiner Niland stated in the interview that although an unexpected result as to surface area increasing for microwave expansion is shown, no correlation is provided directed to the degree of expansion. If applicants can provide probative evidence that conventional heating cannot achieve an expansion of microwave heating, then the claims will be allowable.

The issue of "a few seconds to 5 minutes" related to the objection under 35 U.S.C. § 132 and rejections under 35 U.S.C. § 112 was also raised in the interview. The examiner suggested removing this limitation entirely.

No agreement was reached during the interview.

### **III. DECLARATION UNDER 37 C.F.R. § 1.132**

A Supplemental Declaration under 37 C.F.R. § 1.132 of Professors Larry Drzal and Hiroyuki Fukushima, both inventors of the present application, is being filed herewith. (See attached Supp. Dec.) According to Dr. Drzal and Dr. Fukushima, microwave heating results in a distinctively different product than conventional heating (See. Supp. Dec. ¶ 4). In Dr. Drzal's prior declaration of April 27, 2009, he states that one having skill in the art would never be motivated to attempt microwave heating of graphite (See Dec. 04/27/09, ¶ 9). He provides probative evidence that microwaving graphite provides a much higher degree of expansion as correlated to measured surface area than that achievable through conventional application of heat between 600 and 1,200 °C for the same graphite intercalated material. Moreover, conventional heating does not achieve a degree of expansion of 300 times or more. (See Sup. Dec, Table A1 and Fig. B1; Conventional heating of the graphite provided surface areas of 10.5 and 24 m<sup>2</sup>/g in Table A1 and a surface area of 33 m<sup>2</sup>/g from the 04/27/09 Dec. which corresponds to degree of expansions of 150 or lower depending on the type of graphite used.) Microwave heating can achieve an expansion of 300 times or more as shown in Fig. B1.

The structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art, especially where the product is defined by the process steps by which the product is made, or where the manufacturing process steps would be expected to impart distinctive structural characteristics to the final product. See, e.g., *In re Garnero*, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979). MPEP 2113.

The product-by-process claims should be considered as to the implied structure achieved by microwave heating. Dr. Drzal and Dr. Fukushima make clear the significant difference in microwave heating as compared to conventional heating.

Affidavits or declarations, when timely presented, containing evidence of criticality or unexpected results, commercial success, long-felt but unsolved needs, failure of others, skepticism of experts, etc., must be considered by the examiner in determining the issue of obviousness of claims for patentability under 35 U.S.C. 103. The Court of Appeals for the Federal Circuit stated in *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538, 218 USPQ 871, 879 (Fed. Cir. 1983) that "evidence rising out of the so-called 'secondary considerations' must always when present be considered en route to a determination of obviousness." Such evidence might give light to circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or unobviousness, such evidence may have relevancy. *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966); *In re Palmer*, 451 F.2d 1100, 172 USPQ 126 (CCPA 1971); *In re Fielder*, 471 F.2d 640, 176 USPQ 300 (CCPA 1973). MPEP 716.01(a).

The evidence submitted herewith (i.e., the Supplemental Declaration of Professor Drzal and Dr. Fukushima) needs to be considered in evaluating the claims over the prior art. The Declaration makes clear the difference between microwave heating and the prior art of conventional heating. It also clarifies that one having skill in the art would never be motivated to use microwave heating as an alternative since graphite is conductive.

#### **IV. OBJECTIONS ARE OVERCOME**

The examiner maintains his previous objection under 35 U.S.C. § 132(a) for allegedly introducing new matter into the disclosure for the range "up to five minutes". The claims were amended in the previously filed response to office action of September 25, 2008, to recite "a few seconds to 5 minutes."

As stated in the interview summary above, the examiner suggested removing this subject matter from the claims. Accordingly, the claims have been amended to eliminate the recitation "for a time of a few seconds to 5 minutes" to overcome the section 132 objection and the relevant section 112

rejections discussed below. Applicants request that the objection be withdrawn.

#### **V. REJECTIONS UNDER 35 U.S.C. § 112, 1<sup>ST</sup> AND 2<sup>ND</sup> PARAGRAPHS**

Claim 1-4, 7-8, 10-15, 19-20, 22-23, and 25-33 are rejected under 35 U.S.C. § 112, first and second paragraphs as failing to comply with the written description requirement and being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicants regard as the invention, respectively. In particular, the examiner takes issue with the recitation of: (A) "a few seconds to 5 minutes," (See Office Action, ¶ 5A and ¶ 6A), and (B) "1040 Watts" (See Office Action, ¶ 5B).

##### **(A) Rejections for the limitation "a few seconds to 5 minutes" –**

Claims 1, 2, 12, 13, 22, 23, and 33 have been amended to remove the recitation of "a few seconds to 5 minutes." Applicants submit that these amendments overcome the rejections under 35 U.S.C. § 112, first and second paragraphs.

##### **(B) Rejection of the limitation "1040 Watts"**

The examiner rejects claim 31 for the recitation "1040 Watts" for failing to comply with the written description requirement. Claim 31 has been canceled. Likewise, claims 29, 30, and 32 have been canceled. Each of claims 29-32 had recited "1040 Watts," and in effort to advance prosecution, each has been canceled. Accordingly, applicants submit that this rejection has been overcome.

#### **VI. REJECTION UNDER 35 U.S.C. § 102(b)**

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). As set forth in detail below, applicants respectfully submit

that the applied references fail to disclose all recited limitations of the applicants' claims.

Accordingly, the claims are not anticipated and the applicants request withdrawal of the anticipation rejections of all claims 1-4, 7-8, 10-15, 19, and 29-30.

**A. Summary of the Rejections under 102(b)**

The examiner rejects claims 1-4, 7-8, 10-15, 19, and 29-30 under 35 U.S.C. § 102(b) as being anticipated by Saito with Krassowski and Caines being cited as evidence that the temperatures of Saito give the instantly claimed "worm-like" structure. Particularly, the examiner states, "It is not seen that the heating means of the instant claims gives a different result than that of the patentee via probative evidence that is commensurate in scope with the instant claims and the cited prior art." (See e.g., outstanding action, ¶ 9.)

**B. Summary of the Amendments**

The amendments to independent claims 1, 2, 12, 13, 22, 23, and 33 submitted herein recite "and wherein the precursor graphite is expanded more than graphite treated to 600 °C to 1200 °C by direct application of heat." This expansion is a result of microwaving and provides an unexpected result over conventional heating. The previous declaration of April 27, 2009 provided surface area results and comparisons for expanding graphite through traditional heating versus microwave treatment for the same graphite material. Additional probative evidence in the Supplemental Declaration submitted herewith shows a correlation of surface area to degree of expansion. The probative evidence shows that conventional heating of 600 °C to 1200 °C does not achieve the same degree of expansion as that of microwave heating for the same graphite material.

None of the references teach or suggest a material with graphite expanded more than graphite treated to 600 °C to 1200 °C by direct application of heat. Moreover, expansion of graphite intercalated compounds

was investigated by the applicants to compare conventional heating versus microwave heating as evidenced by the Declaration under 37 C.F.R. § 1.132 by the inventor, professor Lawrence T. Drzal, which was filed on June 22, 2006.

Professor Drzal states in his Declaration that, "graphite expanded by a microwave process has a higher degree of expansion and has a cleaner surface than graphite expanded by a heat treatment." (See Dec. 06/22/06, page 3.) One skilled in the art would not recognize that a cleaner surface could be produced in such a short time with that degree of expansion and cleanliness as a result of microwave heating. The flakes expanded as much as 300 times or more.

The additional probative evidence provided in the current declaration shows the various degrees of expansion and how they correlate to surface area. They show that conventional heating between 600 °C to 1200 °C cannot achieve the surface areas and degrees of expansion as those of microwaves. They further show that conventional heating does not expand the graphite 300 times or more. The actual expansion using microwave treatment is significantly better than conventional heating. The surface is also cleaner. There is no teaching or suggestion in any of the applied references that would indicate these results would be achievable through conventional heating. Thus, it is the particular aspect of microwave that provides these unexpected and surprising results.

None of the references teach an expansion degree of 300 times or more. The Supplemental Declaration submitted hereto provides data that shows expansion of 300 times or more using microwave treatment. Support is provided in the specification at ¶ 69 that states expansion of 300 times or more. These claims overcome any rejection under 35 U.S.C. § 102(b) over the applied references that may be asserted.

Applicants submit that the claims are distinguished over the applied references and request a notice of allowance.



### **C. Summary of the Applied Reference**

As summarized in the previous response to office action, **Saito** teaches that production of expanded graphite from the raw material can be conducted by a known process. "For example, concentrated sulfuric acid is mixed with hydrogen peroxide to form peroxomonosulfuric acid; thereto is added raw material graphite with stirring to give rise to a reaction for about 1 hour to 1 day; and the reacted graphite is heated at 500-1000°C in an inert gas". (Saito, col. 2, lines 59-65). According to Saito, "The present invention may be expanded graphite obtained by adding 15% ammonium hydrogenperoxodisulfate to a mixture of 320 parts by weight of 95 wt. % concentrated sulfuric acid and 4 parts by weight of 62% hydrogen peroxide, mixing them with cooling to 20 °C or lower, adding natural graphite to the mixture to give rise to a reaction for 24 hours, and firing the reaction product up to 1000°C in nitrogen gas" (col. 2, line 67 to col. 3, line 12, emphasis added). Moreover, Saito discloses, "Further, it is necessary that at least 80% of the total particles of the graphite powder used in the present invention have particle diameters of 0.1-20  $\mu\text{m}$ ." (Saito, col. 3, lines 34-36.)

Saito describes using a conventional heating process to expand the graphite. Saito does not disclose or suggest that a microwave process should be used to produce expanded graphite having superior properties as compared to graphite expanded by a high temperature heat treatment. Saito does not disclose or suggest expanding the graphite 300 times or more.

In order to anticipate, Saito must disclose or suggest each element of the claims. Saito does not disclose microwaving or wherein the precursor graphite is expanded more than graphite treated to 600 °C to 1200 °C by direct application of heat. Each of these elements is explicitly recited in the applicants' claims. Since Saito fails to disclose or teach any of these elements individually or as a whole, Saito fails to anticipate the independent claims.

Applicants further reassert the arguments that the structure implied by the process in a product-by-process claim must be considered.

**D. Saito fails to disclose each element of applicants' claims**

Independent claims 1, 2, 12, 13, 22, 23, and 33 of the present application include a product-by-process limitation reciting "expanded by heating in a microwave or radiofrequency applicator... wherein the precursor graphite is expanded more than graphite treated to 600°C to 1200°C by direct application of heat." Each of the independent claims recites expansion of "300 times or more."

The structure implied by the microwave or radiofrequency wave treatment step should be considered. The microwave or radiofrequency wave treatment provides beneficial and structurally different results according to the relevant evidence provided in the prior office action responses.

In particular, the Declaration under 37 C.F.R. § 1.132 by the inventor, professor Lawrence T. Drzal, filed on June 22, 2006 states, "graphite expanded by a microwave process has a higher degree of expansion and has a cleaner surface than graphite expanded by a heat treatment." (See Declaration, page 3.) Included in the Declaration is chapter 2 of the dissertation of Hiroyuki Fukushima (also an inventor of the present application), entitled "Exfoliation Process for Graphite Intercalation Compounds, attached as Exhibit A. This chapter explains that graphite expanded by a microwave process has superior properties as compared to graphite expanded by a heat treatment. The dissertation explains in pertinent part:

- "The surface areas of microwave exfoliated graphite samples were more than 4 times larger than those of the heat exfoliated samples." - Fukushima, page 84, 2nd paragraph. , (Also see, Figure 2.11 and Table 2.1.)

- "It revealed that the microwave process could give a better degree of expansion and a cleaner surface at lower cost." - Fukushima, page 71, 2nd paragraph.

- "By comparing the heating process, Figure 2.4, and the microwave process, Figure 2.6, it was shown that microwave process could give the same or better degree of expansion for graphite flakes." - Fukushima, page 82, 3rd paragraph.

- "It revealed that overall microwave treatment showed a better degree of expansion than conventional heating process, including heating at the temperature of 600°C to 800°C, which is commonly used in the commercial expansion processes." - Fukushima, page 84, 1st paragraph. (See also, Figures 2.7, 2.8, 2.9, and 2.10.)

- "The physical principle of dielectric heating, which includes microwave and radio frequency heating, is based on the transformation of electromagnetic field energy into thermal energy in polar materials. Dipoles of polar materials change their direction by following the direction of the electromagnetic field, causing friction between molecules and transform the applied microwave energy into thermal energy. Microwave process has many advantages over conventional heating such as less energy consumption, faster process, *homogeneous and simultaneous heating throughout the whole sample*, and higher process capacity. Because of these advantages, the microwave process also offers a considerable cost reduction. Fukushima, page 82, 1<sup>st</sup> paragraph.

The fuming inorganic oxy acid has higher dielectric constant than graphite. This enables the radiofrequency waves or microwaves to heat the acid inside the precursor graphite more efficiently, causing explosive expansion of the graphite. Conventional heating methods only heat the graphite gradually from outside, offering relatively slow heating which causes relatively slow and less effective expansion. Conventional heating does not cause the explosive expansion of the graphite through the boiling of the acid like it does through microwave treatment.

The Supplemental Declaration submitted hereto provides Table A1 which shows results from the Fukushima dissertation showing surface area results for conventional heat treatment versus microwave treatment. The correlation of surface areas to degree of expansion for the same graphite is provided in Figure B1. Accordingly, higher surface area for a given graphite sample correlates to higher degree of expansion.

Since the process of microwaving causes a completely different physical effect on the graphite than conventional heating, the two processes (microwave and heating) can not be considered as equivalent to each other. Conventional heating does not cause the graphite to expand 300 times or more.

The examiner states, "It would appear that these different energy forms would lead to the same products, particularly given the lack of specificity of the instant claims in establishing any *unobviously* different structure between the two graphites." (See e.g., outstanding action, ¶ 9; emphasis added.) The examiner has not provided sufficient weight to the comparison provided in the Fukushima dissertation from section 2.3.3, pages 84 – 94. As shown hereinabove by the pertinent portions of the Fukushima dissertation, microwave expanded graphite is significantly different than heat treated graphite.

A consideration of "unobviously different structure" is improper for an anticipation rejection since the prior art reference must disclose each and every element of the applicants' claims.

Saito fails to disclose the process of heating the graphite with radiofrequency waves or microwaves. Saito also fails to disclose expanded graphite that is pulverized to produce the platelets, which consist essentially of a distribution of single platelets. Saito fails to disclose to expand the graphite 300 times or more.

Claims 2 and 13 each recite platelets that have a thickness of about 30 nm. Saito fails to disclose graphite platelets of this thickness. In fact, Saito teaches away from this recitation since it states, "Further, it is necessary that at least 80% of the total particles of the graphite powder used in the present invention have particle diameters of 0.1-20  $\mu\text{m}$ ." (See e.g., Saito, col. 3, lines 34-36.)

Accordingly, Saito fails to disclose each element of applicants' independent claims and thus, the anticipation rejection is overcome. Applicants request that the anticipation rejection be withdrawn.

## **VII. CLAIM REJECTIONS UNDER 35 U.S.C. § 103(a)**

A *prima facie* case of obviousness requires that each and every limitation of the claim is described or suggested by the prior art, or would have been obvious based on the knowledge of those of ordinary skill in the art. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988). Accordingly, the failure of the applied references to teach or suggest all recited claim limitations precludes a conclusion of *prima facie* obviousness. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988); MPEP § 2143.

The references do not teach or suggest the graphite expanded more than the graphite treated to 600 °C to 1200 °C by direct application of heat. Moreover, the references do not teach or suggest expanding the graphite 300 times or more.

The implied structure of the process step of microwave or radiofrequency wave treatment is different than that of Saito alone or in combination with any of the applied references as evidenced by the Declaration filed June 22, 2006. Saito alone or in combination with the applied references fails to disclose, teach, or suggest all recited elements of the claims since neither reference describes the process step of microwave or radiofrequency treatment.

The evidence provided (i.e., the current Supplemental Declaration and previously filed Declaration and appended dissertation) show that microwave treated graphite is unique over conventional heating. In view of the asserted prior art references, this difference is equivocal to unexpected results since neither Saito alone or in combination with any of the applied references disclose, teach, or suggest microwave treated graphite.

Thus, the applicants submit that the present obviousness rejections are traversed. Accordingly, the Office Action fails to present a *prima facie* case of obviousness for all pending claims.

**A. Summary of the Rejections under 35 U.S.C. § 103(a)**

The examiner maintains his rejections from his prior office action rejecting the claims as described in ¶¶ 6 and ¶7 of section (I) above.

**B. Summary of the Applied References**

**Adams** describes a textile fabric coated with an elastomer silicone composition with laminar form. Expanded graphite is mentioned in a range from 5 to 500  $\mu\text{m}$  (microns; 5 to 500  $\times 10^{-6}$  M). These are conventional expanded graphite particles which are much different from those of the present invention which have been expanded with microwaves or radiofrequencies 300 times or more.

**Ottinger** describes conventional expanded graphite in its expanded form as described at paragraph [0036]. The graphite is not expanded using microwaves or radiofrequency heating 300 times or more as in independent Claims 1, 2, 12, 13, 22, 23, and 33.

**Blain** describes a thermal insulating device composed of layers of graphite separated by layers of polymer. Blain teaches that graphite flakes can be exfoliated by exposing them to an energy source, including merely a suggestion of microwave or radiofrequency radiation without any Examples. Blain does not discriminate between microwave radiation and other sources of energy, such as heat sources including a flame or energy provided by infrared radiation in relation to the direction of heating. The graphite is compressed into sheets used to form the shell and not mixed with a polymer or pulverized. As can be seen from the Supplemental Declaration, the microwave treatment provides structural benefits for use in polymer as described above which are not suggested by this reference.

**Cha** describes a process for producing hydrogen and pyrolytic carbon black. There is no discussion of the claimed expanded graphite or its use as a catalyst. This reference is remote from the present invention and one skilled in the art could not possibly derive expanding of graphite using

microwaves or radiofrequency. Claim 22 relates to the conversion of organic compounds.

**Greinke** relates to a lithium ion battery. This reference teaches that graphite is laminated to a metal substrate. An anode is created from exfoliated graphite. The examples refer to "worms" of exfoliated graphite. This reference is remote from the present invention since there is no suggestion of the graphite expanded with microwave or radiofrequency heating as in Claim 23.

**Bonville** describes a "porous graphite" anode alone or in combination with a polymer and catalyst for use in an electrochemical free cell assembly. There is no suggestion of the presently claimed invention comprising microwave or radiofrequency wave expanded from this reference.

**Von Bonin** describes a process for expanding graphite in a mold using a liquid in graphite. Von Bonin teaches that microwaves are one method of heating the expandable graphite, but does not teach advantages of a microwave treatment over conventional heating. There is no suggestion of heating with microwaves or radiofrequency waves.

**C. The applied references alone or in combination fail to disclose, teach or suggest each element of the applicants' claims**

The examiner indicated in his interview that additional probative evidence showing the difference between expansions with conventional heating versus microwave would likely make the claims allowable. The claims are amended to recite in pertinent part, "and wherein the precursor graphite is expanded more than graphite treated to 600 °C to 1200 °C by direct application of heat." Additional probative evidence is provided in the Supplemental Declaration submitted herewith. None of the applied references teach or suggest this result or improvement. None of the references teach or suggest expanding the graphite 300 times or more. Accordingly, since the references alone or in combination fail to teach or suggest every element of the claims, they fail to render the claims obvious.

The graphite in the claims of the present application has been described by a product-by-process limitation. The precursor graphite has been expanded by heating in a microwave or radiofrequency wave applicator. Therefore, the structure implied by the process steps should be considered when assessing the patentability of the claims over the prior art.

Adding energy via microwave or radiofrequency by heating produces different platelets than those of the prior art. The Supplemental Declaration illustrates that graphite expanded by the claimed microwave or radiofrequency process has superior expansion properties as compared to the graphite expanded by a heat treatment.

The graphite expanded by a microwave process has a higher degree of expansion and has a cleaner surface than graphite expanded by a heat treatment. As can be seen in Table 2.1 and in Figure 2.11 on page 88 of the dissertation of Hiroyuki Fukushima, entitled "Exfoliation Process for Graphite Intercalation Compounds." In addition, since intercalated acid residue remaining on the graphite surfaces after treatment could cause problems, the cleanness of the graphite surface is important. Section 2.3.3.2 on page 89 of the dissertation of Hiroyuki Fukushima shows that the microwave treatments have an advantage over the conventional heating process in terms of removal of the residual intercalates. Thus, graphite expanded by a microwave process has superior properties as compared to graphite expanded by conventional heating processes.

**D. The rejection has not properly considered the evidence**

The rejection has not given proper consideration to the evidence previously submitted by the applicants related to microwave heating. Moreover, the rejection has not rebutted the evidence provided in the Supplemental Declaration and associated dissertation. The rejection has not provided evidence or pointed to a reference which would indicate that microwave heating does not provide unique and unexpected results as shown by the applicants.



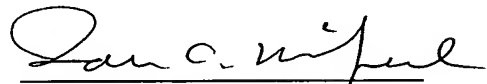
These results are unexpected considering the teachings of the cited references. Particularly, it is unexpected to expand a graphite 300 times or more by using a microwave over conventional heating. None of the cited references alone or in combination teach the advantages of graphite expanded by the claimed microwave or radiofrequency wave process. Saito, Adams, Ottinger, Blain, Cha, Greinke, Bonville, and Von Bonin, either taken alone or in combination, do not disclose, teach or suggest the applicants' independent claims.

The rejection for obviousness has been overcome. Applicants request that the obviousness rejections be withdrawn.

**VIII. CONCLUSION**

The applicants submit that Claims 1-4, 7-8, 10-15, 19-20, 22-23, 25-33 are in condition for allowance. The remarks provided herein overcome the objections and rejections set forth by the examiner. The applied references alone or in combination fail to anticipate and/or render obvious the claims. Accordingly, the applicants respectfully request that a Notice of Allowance be issued and the objections and rejections be withdrawn.

Respectfully,



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